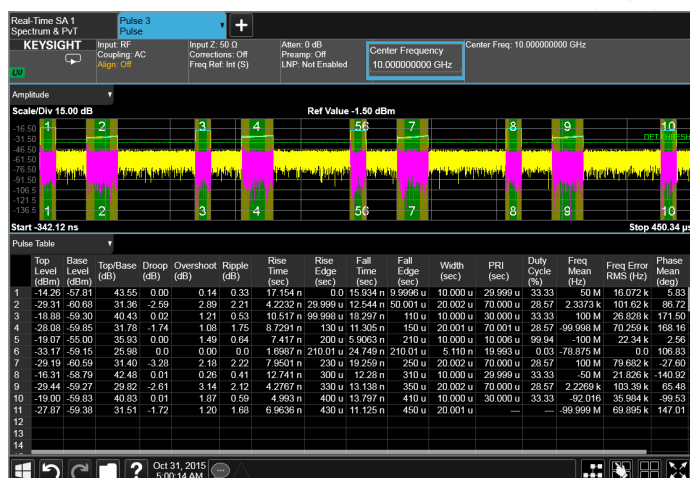# Pulse Analysis X-Series Measurement App, Multi-Touch UI

N9067EM0E

– Automatically synchronize to pulse modulated signals for RADAR and Electronic Warfare (EW) applications up to 50 GHz and bandwidth of 1 GHz
– Verify all key pulse signal modulation performance indicators relating to power, droop, overshoot, ripple, time (rise/fall/width/PRI), frequency, phase, and FM modulation using the comprehensive pulse table result metrics
– Integrates with popular real-time instrument functionality (UXA, PXA, MXA) such as frequency mask trigger
– Capture and export PDW files for playback using Keysight signal generators
– Select from five X-Series signal analyzers with multi-touch to meet your specific design and test goals
– Use multi-touch front panel user interface or SCPI remote control
– Flexible licensing provides the option of using perpetual or time based licenses with one or multiple signal analyzers
– Import or capture reference pulses for pulse scoring and pulse compression measurements

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Pulse Analysis Measurement Application

The Keysight Technologies, Inc. N9067EM0E pulse analysis measurement application for multi-touch signal analyzers provides pulsed RADAR and EW analysis to characterize today's dynamic signal environment. In mission-critical aerospace, defense and EW applications, signal design and validation require comprehensive tools for pulsed radar signal analysis and cross-domain - time, frequency and modulation - test capabilities. To help engineers achieve their design validation goals, the N9067EM0E, a powerful multi-touch application, integrates with the powerful multi-touch X-Series signal analyzers for comprehensive analysis and troubleshooting. The N9067EM0E populates a diverse set of pulse metrics in a flexible table format. All metrics, including pulse table results, result statistics, and cumulative statistics are easily saved into formats such as .csv for custom reports and post analysis.

X-Series measurement applications

X-Series measurement applications increase the capability and functionality of Keysight signal analyzers to speed time to insight. They provide essential measurements for specific tasks in general-purpose, cellular communications, wireless connectivity and digital video applications, covering established standards and modulation types. Applications are supported across X-Series signal analyzers, with the only difference being the level of performance achieved by the hardware you select.

X-Series measurement applications can help you:
- Gain more insight into device performance with intuitive display and graphs for your application. Select from our library of over 25 different measurement applications.
- Ensure that your design meets the latest standard. Updates are made to the X-Series measurement applications as standards evolve.
- Apply the same measurement science across multiple hardware platforms for consistent measurement results over your design cycle from R&D to production.
- Choose the license structure that meets your business needs. We provide a range of license types (node-locked, transportable, floating or USB portable) and license terms (perpetual or time-based).

Top Features

– Verify all key pulse signal modulation performance indicators relating to power, droop, overshoot, ripple, time (rise/fall/width/PRI), frequency and phase, using the comprehensive pulse table result metrics
– Visualize pulse signal modulation characteristics and impairment errors in detail with multiple time-synchronized amplitude, phase, and frequency (FM) trace results, in addition to flexible trace overlay support
– Quickly view statistical variance performance data for each reported pulse metric, accumulated over single or multiple acquisitions, using the pulse cumulative statistics table, graphical histogram, and trend line trace plots
– Gain deeper insights into your signal's time and frequency domain dynamic and spurious performance with powerful and flexible trace views such as spectrogram and cumulative history
– Create and export PDW tables for incoming signals

Pulse analysis in spectrum and time domain with one tool

Traditionally, pulsed RF signals have been designed by RADAR and EW system engineers using a spectrum analyzer for frequency domain characteristics and oscilloscopes for time domain characteristics. Making other frequency and time domain measurements with exactly the same time-sampled data is one of the simplest, yet most important, vector signal analysis techniques. This is especially true when characterizing transient or non-stationary signals such as complex pulsed RF signals in aerospace and defense applications. The pulse analysis application provides simple setup for pulse detection, comprehensive pulse analysis parameters in various traces with visualization and reporting of test results.

Figure 1. Simultaneous views of pulse signals versus time.

Quickly transition from real-time spectrum analysis to pulse analysis

The indispensable real-time trigger capability offered by the RTSA measurement functionality has been integrated into the N9067EM0E pulse analysis measurement application metrics. Using the multi-window capability, going between 510 MHz real-time analysis and automatic pulse measurements has never been easier.
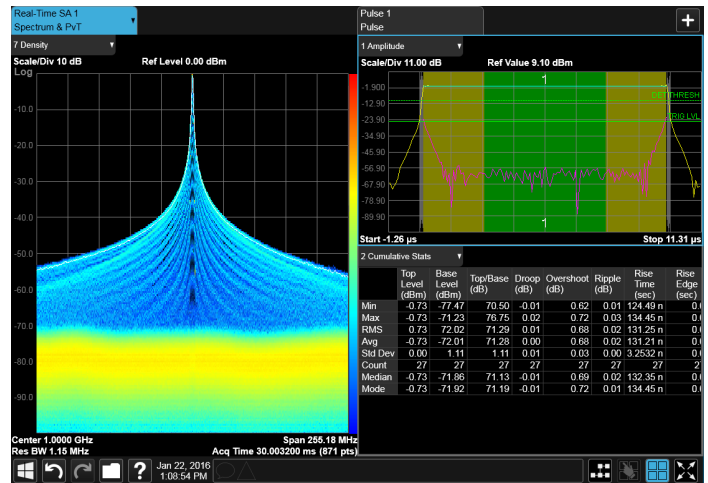

Figure 2. Simultaneous views of pulse magnitude, real-time response and cumulative statistics.

Deeper understanding of RADAR and EW signals with scatter plots

Capturing millions of pulses requires a better way to visualize the enormous amount of data acquired. Scatter plots allow the flexibility of plotting any values of X versus Y such as pulse number versus PRI for staggered PRI radars, chart against frequency to view hopping characteristics and power versus PRI.

Figure 3. See deeper into your signals with scatter plots.

Record pulsed signals directly on the analyzer

Record signals up to 4 GSa and post-process them directly on the analyzer, without the need for external devices. Variable length gated segment capture lets you capture only the pulses you want without off-time, even for signals with variable pulse widths, giving you the longest capture possible.

The PDW capture function will generate UXG-compatible PDW tables from input pulse signals, with both "analog" and "vector" capabilities. These table can be exported for use in Keysight UXG sources.
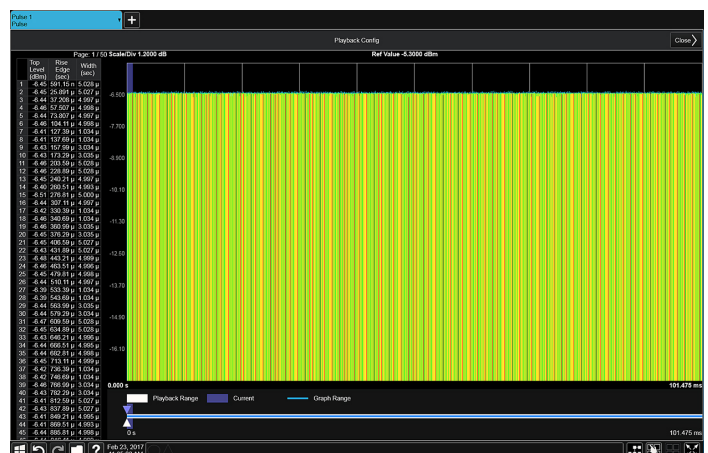

Figure 4. Record and process signals quickly.

Results, statistics and automation

The N9067EM0E pulse table feature gives detailed measurements of each pulse including amplitude, droop, frequency deviation, pulse width, PRI, and dozens of other parameters. The table can auto-detect many common pulse modulation types like LFM, Barker and PSK. Non-linear FM pulses can be modeled using a polynomial fit to quantify the frequency profile. Pulses can also be automatically compressed using a capturer or imported reference pulse, allowing real-time calculation of Time Sidelobe Level (TSLL) and other compression metrics.

All of the pulses on the pulse table can also be analyzed as a group, to show mean and standard deviation values for each parameter and histograms to show trends. Cumulative statistics are also available for aggregating the results of many captures. These tools make it easy to quantify pulse repeatability and identify long-term trends.

Advanced triggering options allow the user to capture or exclude pulses based on amplitude, frequency, pulse width and many other parameters. In addition, captured pulses in the pulse table can be grouped into different "emitters," with each emitter pulse chain evaluated separately.
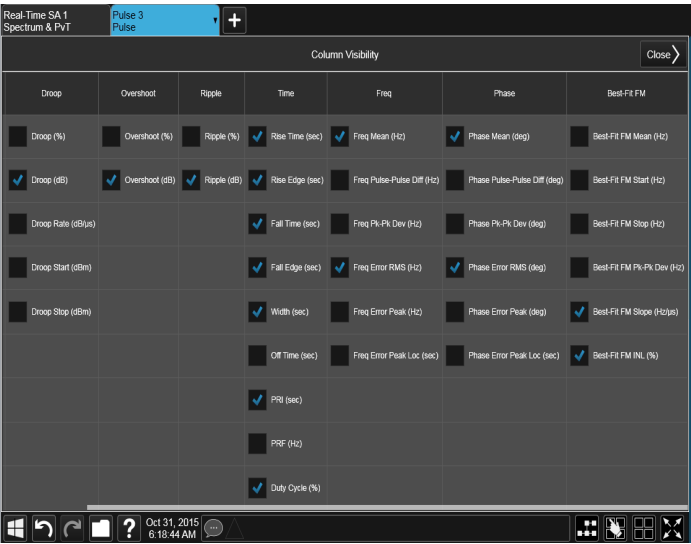

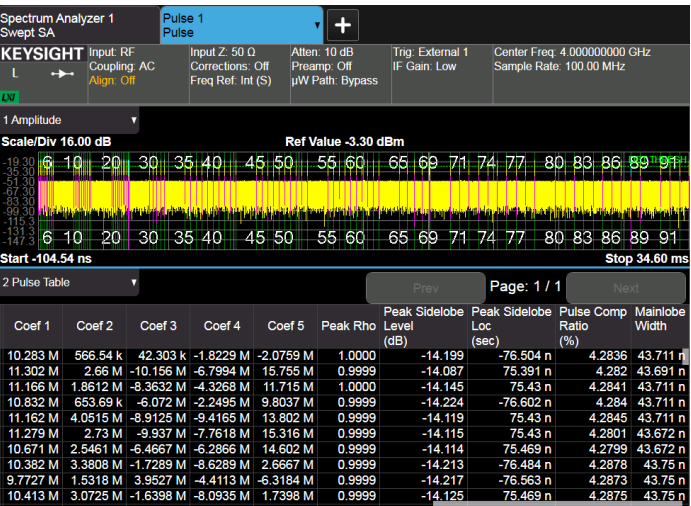Figure 5. Specify results view from extensive list of parameters.

Figure 6. Easily measure pulse linearity and use qualified trigger to select appropriate signal to analyzer.

Measurement Summary

Category	Measurements	Result/Parameter
Amplitude	Amplitude error time, amplitude meas time, amplitude ref time	
Phase	Phase error time, phase meas time, phase ref time	
FM	FM error spectrum, FM error time, FM meas spectrum, FM meas time, FM ref spectrum, FM ref time	
Modulation	Detection of modulation type, demodulation, modulation profile analysis	Modulation type, code, bits, chip width, chip offset, NLFM profile, Costa Spacing, Costa Span
Pulse result table	Level (in dBm, unless otherwise noted)	Top level, base level, top/base ratio (dB), on level, peak level, mean level, peak to average (dB)
	Droop	Droop (%), droop (dB), droop rate (dB/us), droop start (dBm), droop stop (dBm)
	Overshoot	Overshoot (%), overshoot (dB)
	Ripple	Ripple (%), ripple (dB)
	Time (in seconds, unless otherwise noted)	Rise time, rising edge, fall time, falling edge, width, off time, PRI,PRF (Hz), duty cycle (%)
	Frequency (in Hz, unless otherwise noted)	Freq mean, freq pulse-pulse difference, freq pk-pk deviation, freq error time, freq error peak, freq error peak location (sec)
	Phase (in degrees, unless otherwise noted)	Phase mean, phase pulse-pulse difference, phase pk-pk deviation, phase error rms, phase error peak, phase error peak location (sec)
	Best-fit FM (in Hz, unless otherwise noted)	Best-fit FM mean, best-fit FM start, best-fit FM stop, best-fit FM pk-pk deviation, best-fit FM slope (Hz/μsec), best-fit FM INL (%, integral non linearity)
Current statistics table	Same as above results with Min, Max, RMS, Average, Std Dev, Count	
Cumulative statistics table	Same as above results with Min, Max, RMS, Average, Std Dev, Count, Median, Mode	
Compression	Correlation against a reference pulse	Peak Rho, Peak Sidelobe Level (dB), Pulse Compression Ratio (%), Main Lobe Width(s)
Pulse scoring	Scoring pulses against a reference pulse (or pulse chain) using user-selected and weighted parameters like amplitude, center frequency, FM slope, PW and PRI	Score (0 to 1)

Key Specifications

Nominal definition

Nominal values are designated with the abbreviation "nom." These values indicate expected performance, or describe product performance that is useful in the application of the product, but is not covered by the product warranty. Note: Data is subject to change.

PXA (N9030B) Pulse Measurement Accuracy

Description	Specifications	Supplemental information
Amplitude and timing		
		Nominal
Top level [a]		± 0.2 dB + absolute amplitude accuracy (CW)
		± 0.2 dB + absolute amplitude accuracy + IF frequency response (Chirp)
On level [a]		± 0.1 dB + absolute amplitude accuracy (CW)
		± 0.1 dB + absolute amplitude accuracy + IF frequency response (Chirp)
Mean level [a]		± 0.1 dB + absolute amplitude accuracy (CW)
		± 0.1 dB + absolute amplitude accuracy + IF frequency response (Chirp)
Peak level [a]		± 0.2 dB + absolute amplitude accuracy (CW)
		± 0.2 dB + absolute amplitude accuracy + IF frequency response (Chirp)
Width [a]		± 1/sample rate
PRI [a]		± 1/sample rate

a. SNR ≥ 30 dB, pulse width ≥ 100/IF bandwidth.

PXA (N9030B) Frequency and Phase

Description	Specifications	Supplemental information	
Frequency error RMS [a]			
	Unmodulated pulsed signal [b]		**Chirp (linear chirp signal)**[c]
	20 to 30 °C	Nominal	Nominal
CF 2 GHz			
– *Option B2X*	± 100 kHz	± 55 kHz	± 70 kHz
– *Option B5X* [d]	± 260 kHz	± 160 kHz	± 160 kHz
CF 10 GHz [e]			
– *Option B2X*	± 160 kHz	± 85 kHz	± 85 kHz
– *Option B5X* [d]	± 410 kHz	± 240 kHz	± 250 kHz
CF 20 GHz [f]			
– *Option B2X*	± 300 kHz	± 150 kHz	± 140 kHz
– *Option B5X* [d]	± 820 kHz	± 430 kHz	± 400 kHz
Frequency pulse to pulse difference [g]			
CF 2 GHz			
– *Option B2X*	± 200 kHz	± 65 kHz	± 80 kHz
– *Option B5X* [d]	± 550 kHz	± 190 kHz	± 210 kHz
CF 10 GHz [e]			
– *Option B2X*	± 350 kHz	± 100 kHz	± 120 kHz
– *Option B5X* [d]	± 850 kHz	± 280 kHz	± 320 kHz
CF 20 GHz [f]			
– *Option B2X*	± 660 kHz	± 200 kHz	± 210 kHz
– *Option B5X* [d]	± 1800 kHz	± 520 kHz	± 580 kHz
Phase pulse to pulse difference			
CF 2 GHz			
– *Option B2X*	± 0.45°	± 0.2°	± 0.25°
– *Option B5X* [d]	± 0.6°	± 0.25°	± 0.3°
CF 10 GHz [e]			
– *Option B2X*	± 0.95°	± 0.45°	± 0.5°
– *Option B5X* [d]	± 1.0°	± 0.4°	± 0.5°
CF 20 GHz [f]			
– *Option B2X*	± 1.6°	± 0.7°	± 0.8°
– *Option B5X* [d]	± 1.9°	± 0.8°	± 0.9°

a. Frequency/Phase analysis setup:
    Width = 50%
b. Atten = 0 dB, IF Gain = Auto.
    Signal condition:
    Pulse on power = –10 dBm
    Pulse width ≥ 100/IF bandwidth
    Modulation setup:
    FM filter bandwidth = 20%
c. Atten = 0 dB. IF Gain = Auto.
    Signal condition
    Pulse on power = –10 dBm
    Pulse width ≥ 1000/IF bandwidth
    Chirp deviation ≤ 80% of IF bandwidth
    Modulation setup
    FM filter bandwidth = 20%.
d. Requires Option EP0.
e. Option LNP reduces losses that occur before noise-setting and compressive stages. As a result, the sensitivity improves by about 6 dB, but the maximum
    signal handling ability falls by the same amount.
f. Footnote d applies except to the extent of 8 dB.
g. Pulse to pulse analysis setup:
    Reference time = Center
    Offset = 0.0 s
    Window length = 0.0 s

UXA (N9040B) Pulse Measurement Accuracy

Description	Specifications	Supplemental information
Amplitude and timing		
		Nominal
Top level [a]		
– CW		± 0.2 dB + absolute amplitude accuracy
– Chirp		± 0.2 dB + absolute amplitude accuracy
		+ IF frequency response
On level [a]		
– CW		± 0.1 dB + absolute amplitude accuracy
– Chirp		± 0.1 dB + absolute amplitude accuracy
		+ IF frequency response
Mean level [a]		
– CW		± 0.1 dB + absolute amplitude accuracy
– Chirp		± 0.1 dB + absolute amplitude accuracy
		+ IF frequency response
Peak level [a]		
– CW		± 0.2 dB + absolute amplitude accuracy
– Chirp		± 0.2 dB + absolute amplitude accuracy
		+ IF frequency response
Width [a]		± 1/sample rate
PRI [a]		± 1/sample rate

a.   SNR ≥ 30 dB, pulse width ≥ 100/bandwidth.

UXA (N9040B) Frequency and Phase

Description	Specifications	Supplemental information	
Frequency error RMS [a, b]			
	20 to 30 °C	**CW (Non-chirp signal)**	**Chirp (Linear chirp signal)**
CF 2 GHz		Nominal	Nominal
– *Option B2X*	± 100 kHz	± 55 kHz	± 65 kHz
– *Option B5X*	± 260 kHz	± 160 kHz	± 160 kHz
– *Option H1G*		± 390 kHz	± 550 kHz
CF 10 GH [c]			
– *Option B2X*	± 150 kHz	± 85 kHz	± 85 kHz
– *Option B5X*	± 410 kHz	± 240 kHz	± 250 kHz
– *Option H1G* [d]		± 680 kHz	± 730 kHz
CF 20 GHz [e]			
– *Option B2X*	± 300 kHz	± 150 kHz	± 140 kHz
– *Option B5X*	± 820 kHz	± 430 kHz	± 400 kHz
– *Option H1G* [d]		± 800 kHz	± 950 kHz
Frequency pulse to pulse difference [f, a]			
CF 2 GHz			
– *Option B2X*	± 200 kHz, ± 0.4°	± 65 kHz, ± 0.15°	± 80 kHz, ± 0.2°
– *Option B5X*	± 550 kHz, ± 0.6°	± 190 kHz, ± 0.2°	± 210 kHz, ± 0.3°
– *Option H1G* [d]		± 480 kHz, ± 0.3°	± 490 kHz, ± 0.35°
CF 10 GHz [c]			
– *Option B2X*	± 320 kHz, ± 0.65°	± 100 kHz, ± 0.25°	± 120 kHz, ± 0.35°
– *Option B5X*	± 850 kHz, ± 1.0°	± 280 kHz, ± 0.35°	± 320 kHz, ± 0.5°
– *Option H1G* [d]		± 870 kHz, ± 0.5°	± 950 kHz, ± 0.6°
CF 20 GHz [e]			
– *Option B2X*	± 630 kHz, ± 1.25°	± 190 kHz, ± 0.4°	± 210 kHz, ± 0.6°
– *Option B5X*	± 1800 kHz, ± 1.9°	± 520 kHz, ± 0.8°	± 580 kHz, ± 0.9°
– *Option H1G* [d]		± 1000 kHz, ± 0.65°	± 1100 kHz, ± 0.7°

a. ATT = 0 dB, IF Gain = Low, LNP = off.
    Signal condition:
    Pulse on power = -10 dBm
    Pulse width ≥ 100/bandwidth
    Modulation setup:
    FM filter bandwidth = 10%
b. Frequency/Phase analysis setup:
    Width = 50%
c. Option LNP reduces losses that occur before noise-setting and compressive stages. As a result, the sensitivity
    improves by about 6 dB, but the maximum signal handling ability falls by the same amount.
d. IF Gain = Low.
e. Footnote c applies except to the extent of 8 dB.
f. Pulse to pulse analysis setup:
    Reference time = Center
    Offset = 0.0 s
    Window length = 0.0 s

For a complete list of specifications, refer to the appropriate specifications guide:
  – UXA: www.keysight.com/find/uxa_specifications
  – PXA: www.keysight.com/find/pxa_specifications
  – MXA: www.keysight.com/find/mxa_specifications
  – EXA: www.keysight.com/find/exa_specifications

Ordering Information

Flexible licensing and configuration

- **Perpetual:** License can be used in perpetuity.
- **Time-based:** License is time limited to a defined period, such as 12-months.
- **Node-locked:** Allows you to use the license on one specified instrument/computer.
- **Transportable:** Allows you to use the license on one instrument/computer at a time. This license may be transferred to another instrument/computer using Keysight's online tool.
- **Floating:** Allows you to access the license on networked instruments/computers from a server, one at a time. For concurrent access, multiple licenses may be purchased.
- **USB portable:** Allows you to move the license from one instrument/computer to another by end-user only with certified USB dongle, purchased separately.
- **Software support subscription:** Allows the license holder access to Keysight technical support and all software upgrades.

You Can Upgrade!

All of our X-Series application options are license-key upgradeable.

UP GRADE

Pulse analysis measurement app (N9067EM0E)

Software license type	Support contract	Support subscription (12-month) [2]
Node-locked perpetual	R-Y5C-001-A	R-Y6C-001-z [2]
Node-locked time-based	R-Y4C-001-z [1]	Included
Transportable perpetual	R-Y5C-004-D	R-Y6C-004-z [2]
Transportable time-based	R-Y4C-004-z [1]	Included
Floating perpetual	R-Y5C-002-B	R-Y6C-002-z [2]
Floating time-based	R-Y4C-002-z [1]	Included
USB portable perpetual	R-Y5C-005-E	R-Y6C-005-z [2]
USB portable time-based	R-Y4C-005-z [1]	Included

Try before you buy!

Evaluate a full-featured version of our X-Series measurement application with our *FREE* trial. Redeem one 30-day trial license of each measurement application online at: www.keysight.com/find/X-Series_apps_trial

One month KeysightCare software support subscription extensions [3]

Model	Description
R-Y6C-501 [3]	1-month of software support subscription for node-locked license
R-Y6C-502 [3]	1-month of software support subscription for floating license
R-Y6C-504 [3]	1-month of software support subscription for transportable license
R-Y6C-505 [3]	1-month of software support subscription for USB portable license

Hardware configurations

To learn more about compatible platforms and required configurations, please visit: www.keysight.com/find/X-Series_apps_platform

Software models and options

To learn more about X-Series measurement application licensing, model numbers and options, please visit: www.keysight.com/find/X-Series_apps_model

1. z means different time-based license duration. F for 6 months, L for 12 months, X for 24 months, and Y for 36 months. All time-based licenses have included the support subscription same as the time-base duration.
2. z means different support subscription duration. L for 12 months (as default), X for 24 months, Y for 36 months, and Z for 60-months. Support subscription must be purchased for all perpetual licenses with 12-months as the default. All software upgrades and KeysightCare support are provided for software licenses with valid support subscription.
3. Support subscription for all perpetual licenses can be extended with monthly extensions.

Hardware Configuration

For optimizing the utility of the pulse analysis application, Keysight recommends a minimum level of X-Series multi-touch signal analyzer hardware at each instrument performance point. Supported instruments include:

Benchtop:
- UXA N9041B [1]
- UXA N9040B
- PXA N9030B
- MXA N9020B
- EXA N9010B

N90x0B X-Series signal analyzer

Capability	Instrument option	Benefit
Analysis bandwidth	10 or 25 MHz as default or higher	**Required:** Wider analysis bandwidth to support enhanced sample interval, time resolution, rise/fall time and minimum pulse width
Microwave pre-selector by-pass	-MPB	**Required:** For frequency mask triggering. **Recommended:** For all pulse analysis
Real-time spectrum analyzer	-RT1 or –RT2	**Recommended:** Detect signals as short as 3.33 ns with 100% POI
2GB or 4GB Capture Memory	-DP2 or -DP4	**Recommended:** large capture memory is required for record & playback, and also fast spectrum measurement
Frequency mask trigger	-FT1 or –FT2	**Recommended:** Focus on the signal of interest in a complex signal environment
Pre-amplifier	3.6 GHz (-P03) or higher	**Recommended:** For maximizing the measurement sensitivity
Fine resolution step attenuator	-FSA on EXA and CXA only	**Recommended:** Useful for maximizing useable dynamic range to see signals
Duplex IF RTSA	-DUA	**Recommended:** Allows duplex operation of RTSA capability to allow simultaneous narrowband and wideband analysis. Requires Options B5X, RT1 and RT2

Note 1: Currently pulse analysis measurement application has only been qualified for UXA N9041B Input 1 Port.

Specific pulse analysis required options

	Record & Playback (Normal Acquisition)	Record & Playback (Gated Acquisition)	With Frequency Mask Trigger (FMT) or Time Qualified Trigger (TQT)	With Fast Spectrum measurement
N9010B EXA	DP2	N/A	N/A	DP2
N9020B MXA	DP2 or DP4	Require DP4	N90EMFT1B or N90EMFT2B	DP2 or DP4
N9021B MXA	DP2 or DP4	Require DP4	R N90EMFT1B or N90EMFT2B	DP2 or DP4
N9030B PXA	DP2 or DP4	Require DP4	N90EMFT1B or N90EMFT2B	DP2 or DP4
N9032B PXA	N/A	N/A	N/A	N/A
N9040B UXA (Port 1 only)	DP2 or DP4	Require DP4	N90EMFT1B or N90EMFT2B	DP2 or DP4
N9041B UXA	DP2 or DP4	Require DP4	N90EMFT1B or N90EMFT2B	DP2 or DP4

Note
- Option DP2 (2 GHz memory) can be ordered individually, or is included in Option B40 (40 MHz BW), B85 or wider IQ BW option
- Option DP4 (4 GHz memory) can be ordered individually, or is included in Option B85 or wider IQ BW option
- N90EMFT1B and N90EMFT2B can be ordered each individually, or are included in N90xxRT1B and N90xxRT2B (RTSA), respectively

Additional Information

– Pulse X-Series measurement app, multi-touch UI product webpage
  www.keysight.com/find/N9067E

– X-Series measurement applications:
  www.keysight.com/find/X-Series_Apps

– X-Series signal analyzers:
  www.keysight.com/find/X-Series

Learn more at: www.keysight.com

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at: www.keysight.com/find/contactus

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